IN THE SPECIFICATION

Page 1, line 2 to page 2, line 9 have been amended as follows:

CROSS REFERENCE

The present application is a national phase of International Appln. No. PCT/DK99/00543 filed October 12, 1999, which claims the benefit of U.S. Provisional Appln. No. 60/103,953 filed October 13, 1998.

BACKGROUND

The present invention relates to a cleaning and/or treatment device for cleaning and/or treating surfaces such as floors, pavements and carpets. The invention particularly relates to a cleaning and/or treatment device using cleaning/treatment solution, wherein the solution is recirculated and thereby used more than one time. The invention also relates to a process of cleaning and/or treating surfaces using ~~a such~~ **such a** device.

Cleaning devices such as floor scrubbers and carpet cleaners using detergent solutions comprising water and detergent (detergent solution is in the following referred to as solution) are well known in the art. Most of the known cleaning ~~devises uses~~ **devices use** the solution only once, and consequently **[[uses]] use** a lot of solution under operation. The general way of operating a floor scrubber or a carpet cleaning machine is firstly to prepare a solution. The solution is then placed in a clean solution tank of the machine**. From the clean solution tank,** ~~and therefrom~~ the solution is fed to the surface (hard floor, carpet e.t.c.) and spread onto said surface. The surface is cleaned using the dissolving power of the detergents, and may further be cleaned by mechanical means such as a brush. The mixture of dirt and solution is finally removed from the surface e.g. by using a squeegee and transported to a "dirty solution tank" of the machine. The dirty solution must then be disposed of (typically to the sewer) . A new solution is prepared and filled into the machine, and the cleaning process may be continued.

As it ~~appear~~ **appears** from the above description, much operation time is required for emptying the dirty solution tank and refilling the cleaning device with fresh solution. Furthermore, cleaning devices using the solution only once, should either have a large supply tank or can only operate for a very short time. Another ~~disadvantages~~ **disadvantage** of the above mentioned cleaning ~~devises~~ **devices** using solution only once is that a lot of solution comprising unused detergents is discarded into the environment which is both expensive and

polluting to the environment. In order to avoid this problem, a number of cleaning devices having means for recirculating solution have been suggested.

Page 2, lines 19-30 have been amended as follows:

US 4,194,263 ~~disclose~~ **discloses** a scrubber comprising a clean solution tank and a dirty solution tank. A separator is placed **[[in]]** between the clean solution tank and the dirty solution tank to separate the dirty solution into a sludge portion which is returned to the dirty solution tank, and a clean solution which is returned to the clean solution tank for being reused. The separator is a laminar flow tube settler.

A similar scrubber is known from US 4,295,244. In this scrubber, the separator has been replaced by a series (a box) of sedimentation chambers.

Page 3, lines 1-25 have been amended as follows:

EP 0 224 055 A2 ~~disclose~~ **discloses** a similar cleaning device comprising a clean solution tank and a dirty solution tank. The two tanks are openly connected, and when passing from the dirty solution tank to the clean solution tank, solution has to pass a first filter with large mesh size and a fine filter for separating dirt from the solution.

In US 5,535,476, a mobile cleaning apparatus with a clean solution tank and a dirty solution tank is disclosed. This apparatus ~~comprising~~ **includes** a system of cleaning the dirty solution comprising a sieveplate in the dirty solution tank and a filter bag in the clean solution tank.

In US 3,753,777, a method for cleaning surfaces is disclosed. In this method, a flocculant (polyelectrolytes) is added to the dirty solution in order to create "flocs of dirt", ~~and thereafter,~~ **Thereafter,** these flocs of dirt are removed using a sieve or a filter. Hereafter, the solution may be recycled. Adding polyelectrolytes (flocculants) to the solution will often cause less dissolving power of detergents present in the solution since these detergents often chemically bind to the flocculant, and thus cause either increased use of detergents or a less optimal cleaning result.

Page 3, line 31 to page 4, line 30 have been amended as follows:

The "dirt" and debris present in the dirty solution **[[is]]** **are** normally a mixture of particles having all shapes, regular or irregular, and typical densities varying from 0.1 to 10 g/cm^3. For sedimentation to take place, sedimentation time and physical conditions (rest) are important factors.

Sedimentation is not an effective separation technique for separating particles with ~~spec.gravities~~ **specific gravities** < 1.00 g/cm^3.

For example, a 10 μm sphere ([[spec.]] **specific** gravity **[[1,1]] 1.1** g/cm^3) sinking in a slurry or "dirty water" solution (a low solids concentration water suspension with **[[spec.]] specific** gravity ~~approx.~~ **of approximately** 1.0 g/cm^3) using Stokes law (anticipating laminar movement) results in a ~~Settling~~ **settling** velocity V_s:

$$V_s = D^2 * g * (p_p - p_w) / 18 * \mu_w = 5.45 * 10^{-6} \text{ m/sek}$$

This means that such a sphere will require 1835 seconds to travel 1 cm. From this, it can be concluded that the separator ~~require~~ **requires** a residence time of the order of about 31 minutes. In the case where the dirty solution is a high solids concentration suspension, the residence time will increase further, due to the hindrance from the other solids in the solution. Addition of surface active materials, such as detergents, may further increase the sedimentation time. Solution consumption in ~~for example~~ floor scrubbers, **for example,** is of the order 1-10 1/min. Thus, the volume (size) of the separator unit becomes quite large and impractical for moving machines when small dirt particles (approximately 10 μm) must be removed. Practically, it is not possible to obtain a clear cleaned solution from a dirty solution by using sedimentation separation only. This will be shown later on in the section "Sedimentation of dirt".

Page 4, line 32 to page 5, line 24 have been amended as follows:

Using filters as described in the above apparatus and methods have other disadvantages. The filters in all the devices described in the above mentioned patent publications are simple filters having a relatively open mesh. Such filters will not stop all visible particles. By applying several such filters in series each having still finer mesh size, the solution may become relatively clear as described in US 5,331,713 (White Cons. Ind.), but all traditional filters, as used in the known cleaning ~~devises~~ **devices**, will clog. In the 4-filter-system described in US 5,331,713, the dirt is captured in the filter system, and no regeneration of the filters is described. Such "in-dept filter types" require frequent replacement, even when the particle or "dirt" load in the dirty solution is relatively low. Filtration of high "dirt" loaded solutions is practically ~~impossibly~~ **impossible**.

SUMMARY

The object of the present invention is to provide a cleaning and/or treatment device for cleaning and/or treating surfaces such as floors, pavements and carpets, which device comprises simple and effective regeneration equipment, and by use of which ~~devise~~ **device,** used cleaning/treatment solution can be regenerated as a clear cleaned solution.

Another object of the invention is to provide a cleaning and/or treatment device which can reuse the solution several **[[time]]** **times** with as little loss of water and detergent/treatment chemicals as possible.

Page 5, lines 30-33 have been amended as follows:

A further object of the invention is to provide a method of regeneration a dirty solution from **[[a such]]** **such a** cleaning and/or treatment device, which method is effective and simple.

Page 6, lines 1 to page 8, line 25 have been amended as follows:

In view of the prior art cleaning devices with recirculating solution, it is very surprising that it is possible to provide filter-systems that effectively ~~separates~~ **separate** dirt and particles from the dirty solution without clogging of the filter means, while the device is operating.

The present invention provides a new recycling technology for cleaning and/or treatment devices. By using the present invention as defined in the claims, collected dirty solution can be cleaned in the filter unit of the device, so that a clear solution, determined by visual inspection, can be obtained, and this cleaned clear solution can be recycled back into the clean solution tank. Water and unused detergent and/or treatment chemicals may be recycled back to the clean solution tank and used again several times.

In the following, the term "cleaning device" includes devices for cleaning and/or treating surfaces.

When the device is used for treating surfaces, the clean solution contains one or more treatment chemicals, such as chemicals for improving the gloss of a floor or chemicals for providing a carpet with anti-static properties. In some situations, it is preferred that the cleaning solution may contain both treatment chemicals and detergents, provided that the chemicals and detergents **[[does]]** **do** not ~~interacts~~ **interact** in **[[a]]** **an** undesired way.

The cleaning device of the present invention ~~comprise~~ **comprises** a clean solution tank and a dirty solution tank. The size and shape of these tanks are not important. The cleaning device further ~~comprise and~~ **comprises** a movable cleaner head, which cleaner head comprises at least one solution supply opening for supplying clean solution to a surface and at least one

solution recovery opening for recovering dirty solution from a surface. In situations where the cleaning device is not adapted for cleaning or treating carpets, a squeegee may preferably be placed close to the recovery opening. The solution supply opening is connected to the clean solution tank, so that it is in solution communication with the clean solution tank. The solution recovery opening is connected to the dirty solution tank, so that it is in solution communication with the dirty solution tank. The cleaning device further comprises means for supplying solution from said clean solution tank through said supply opening, preferably in the form of gravity or in the form of a pump. Further, the cleaning device comprises suction means for recovering solution through said recovery opening to said dirty solution tank.

The clean solution tank, the dirty solution tank and the cleaner head may have any shape and size. The clean solution tank is preferably not smaller than the dirty solution tank. It is particularly preferred that the clean solution tank and the dirty solution tank have similar size. In some situations, which, however, **[[is]]** **are** not preferred, the dirty solution tank may be constituted by the pipeline that ~~**transfer**~~ **transfers** the used ~~**solutiobn**~~ **solution** from the cleaner head to the filter unit. The cleaner head is designed to the type of surface that the cleaning device should clean and/or treat. The cleaner head may preferably be ~~**replaeable**~~ **replaceable**. A preferred cleaner head may comprise any type of scrubbing means e.g. a rotary brush or brushes in connection with the supply opening. The cleaner head further may comprise a squeegee ~~**a squeegee**~~ placed close to the recovery opening. The preferred size and shape of the cleaner head depends on the type of surface it is adapted to clean. In some devices according to the invention, the cleaner head is divided into two sections, a first section for supplying fresh solution, and a second section for recovering dirty solution. These two sections may be physically separated from each other.

For most types of cleaning ~~**devises**~~ **devices,** it is preferred that the means for supplying solution from the clean solution tank through the supply opening is gravity. However, for some types of cleaning devices, such as carpet cleaners, the means for supplying solution from the clean solution tank through the supply opening may preferably be a pumping means.

The cleaning device may be **movable** provided by any size and **[[styles]]** **style moving means** and may preferably comprise wheels. The movable cleaner head may be movable with respect to the solution tanks or in that the whole cleaning device is movable.

It is preferred that the cleaning ~~devise~~ **device** is a floor scrubber or a carpet cleaner, and except for the filter unit, it may preferably be similar to the cleaners described in the ~~advance~~ **ADVANCE™** brochure "~~Advance~~ **ADVANCE™**, Commercial and Industrial Cleaning Equipment" 1994 Form No. 28493 8/94 and "~~Advance~~ **ADVANCE™**, Commercial Cleaning Equipment" 1996 Form No. L0377A, 4/96.

Page 8, line 34 to page 9, line 6 have been amended as follows:

The filter unit preferably ~~comprise~~ **comprises** a membrane filter, and more preferably, a cross-flow membrane filter. Such membrane filters are **[[know]] known** from the art of separating proteins, micro-organism and the like from fluids. Membrane filters are also known from the technology of separating oil emulsions used in water-based cooling agents. **[[I this]] In these** systems, the oil emulsions **[[is]] are** retained by the membrane, and water and solutes ~~passes~~ **pass** the membrane filter.

Page 9, line 13 to page 11, line 28 have been amended as follows:

It is preferred that the filter unit ~~comprise~~ **comprises** a solid membrane filter. The membrane may have any thickness e.g. from 1 mm to 1 cm. The membrane may preferably have **[[pores]] pore** size between 10 - 10,000 kD or between 0.001 - 5 μm. The membrane filter can be made from any ~~suitably~~ **suitable** material such as ceramics, graphite, metals, metaloxides, papers and polymers. In the present invention, it is particularly preferred that the membrane filter comprises a membrane made of one or more materials selected from polymeric materials, ceramic materials, and metals.

The structure of the membrane may be symmetric (meaning that the pore diameters **[[does]] do** not vary over the membrane cross section) or it may be asymmetric so that the pore diameters ~~increases~~ **increase** from one side of the membrane to the other by a factor **[[op]] of up** to about 100.

~~Suitably~~ **Suitable** membrane filters are described in DE patent publication 26 53 875, US patent No. 4,915,837, US patent No. 4,726,900, US patent No. 4,990,256 and US patent No. 5.681,469, which **[[is]] are** hereby incorporated by reference.

The membrane filter of the filter unit is preferably packed in a flat, spiral wound, tubular fibre type configuration. Most preferred are tubular fibre type ~~configuration~~ **configurations**, such as "spaghetti" or hollow tubular fibre type ~~configuration~~ **configurations**.

In a cross-flow filter, no filter cake formation or "in-depth" filtration takes place. The filter surface should be sufficiently open to allow for water to pass it. It is preferred that the filter surface is sufficiently open to allow for unused detergent to pass it. At the same time, it is preferred that the filter surface should not be more open than **this so that** it is able to retain essentially all of the particles that cause turbidity in the recycled solution. Thereby, visual deterioration of the cleaning result (floor appearance etc.) may be avoided.

In a particularly preferred embodiment of the cleaning device of the invention, particularly a floor scrubber or a carpet cleaner, the filter unit further comprises a coarse screen unit for precleaning the dirty solution before it enters the membrane filter. This coarse screen unit may comprises one or more screens preferably having a mesh width in the range 50 - 2.000 μm. In most ~~situation~~ **situations,** it is sufficient if the coarse screen unit ~~comprise~~ **comprises** one or two screens.

If the cleaning device should be used in cleaning very dirty surfaces, particularly dirty floors such as floors in automobile shops, it is preferred that the coarse screen unit ~~comprise~~ **comprises** multiple screens, e. g. up to 5 coarse screens, with decreasing mesh width, arranged in a sandwich structure.

In a preferred embodiment of the invention, the cleaning device further ~~comprise~~ **comprises** a pumping means for pumping clean solution from the clean solution tank in a back-flush through the filter unit, whereby the filter unit is regenerated.

When the pumping means for pumping clean solution from the clean solution tank in back-flush through the filter unit is **in** operation, the pumping means for pumping dirty solution through the filter unit may continue operating.

It is preferred that the pumping means for pumping clean solution from the clean solution tank in a back-flush through the filter unit is controlled by an automatic control unit for starting and stopping said pumping means. More preferably, all of the pumps and the valves of the cleaning ~~devise~~ **device** are controlled by an automatic control unit.

~~Further more~~ **Furthermore,** it is preferred that the cleaning device is constructed in a way whereby the filter unit, the pumps and the valves of the device are easy **[[of]] to** access.

The present invention also ~~comprise~~ **comprises** a cleaning device in combination with a filtering station ~~as defined in claim 12~~. In this aspect of the invention, the cleaning device is separated from the filter unit, but is adapted to be connected to the filter unit for regeneration of

dirty solution, preferably by use of a snap lock ~~devise~~ **device** or a quick connection. Such snap lock devices and quick connections are generally known.